also pointed the way to further developing a mechanistic account of cellular functions in terms of the component parts found in cells and their operations, but was not in position to develop a detailed account himself; that task was left for later scientists.

Although Schwann's contention that cells were the basic building blocks of all organisms was widely accepted, his and Schleiden's mechanism for cell formation became the focus of controversy. Researchers such as Barthélemy Dumortier (1832) and Hugo von Mohl (1837) reported observations of dividing cells in *Conferva aurea* even before Schleiden's publication,[13] and von Mohl as well as Franz Unger and Carl von Nageli continued in subsequent years to develop ever more detailed descriptions of cell division. These included observations that the division of the nucleus preceded the division of the cell itself. Even von Mohl, though, allowed that sometimes cells formed like crystals and for a number of years the two accounts, cell division and Schleiden's and Schwann's accounts, were considered to provide two ways in which new cells were created. Rudolf Virchow (1858), a pathologist, and Robert Remak (1852; 1855) provided what turned out to be the decisive argument against Schwann's account – it amounted to spontaneous generation.[14] Virchow argued instead that each cell arises from a pre-existing cell (*omnis cellula e cellula*).[15] Virchow could offer no specific mechanism for cell division, but he was not as committed to mechanism as Schleiden and Schwann. He viewed the difference between healthy and pathological life as involving organizational properties of whole cells. Accordingly, he characterized his approach to pathology as "cellular pathology" (Virchow, 1855) and appealed

molecules. The cause of nutrition and growth resides not in the organism as a whole, but in the separate elementary parts – the cells" (Schwann, 1839/1947, p. 192).

[13] Schleiden actually cited von Mohl's paper, but contended that von Mohl was deceived by the smallness and transparency of the new cells that had formed in the old ones and so was led to see the final breaking free of these new (and already fully developed) cells from the mother cell as a process of cell division.

[14] Remak (1852) commented, "As for myself, the extracellular formation of animal cells struck me, from the very moment that this theory was propagated, as no less improbable than the generation aequivoca of organisms" (translated by Henry Harris (1999, p. 130). There is irony in the contention that Schwann's theory of cell formation amounted to spontaneous generation because in his paper on fermentation he had come down against spontaneous generation by demonstrating that fermentation required a microorganism that was killed by heat (Schwann, 1837).

[15] The expression was not original with Virchow. François-Vincent Raspail (1825) used it as an epigraph. When Virchow first employed the phrase, he wrote it "omnis cellula a cellula," a more ambiguous expression asserting only that all cells arise by means of cells rather than explicitly deriving from them.